Creating a Microcontroller-Based, Non-Invasive, Multi-Modal, Photoplethysmographic Monitor

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Physiologic monitoring is a valuable tool for maintaining and monitoring the health of patients. The purpose of this project was to create a noninvasive, photoplethysmographic device that could monitor physiologic data transcutaneously. The researcher hypothesized that this could be accomplished by creating a microcontroller-based device to detect and record changes in light absorption through skin tissue; this data could then be converted into meaningful information used to calculate pulse rate and blood-oxygen saturation. The researcher devised a circuit consisting primarily of a TSL light-to-frequency converter, red LED, infrared LED, and external memory chip, all directed and linked by a Parallax BS2p microprocessor on a professional development board. The device was designed so that light would pass from the LEDs though the tissue of a finger placed directly on its surface and into the sensor. The researcher then authored a program designed to give the user multiple options including device calibration, writing data to a memory chip, reading data from the chip, and validation of data integrity. The device was designed around the principle that blood pulses throughout the body in surges, causing the absorption of light to vary in a pulse-like fashion. From this raw absorption data, pulse waveforms can be constructed. Comparison of red and infrared absorption waveforms by deoxyhemoglobin and oxyhemoglobin, respectively, allow one to calculate pulse rate and blood-oxygen saturation using the Beer-Lambert equation. The researcher succeeded in fulfilling his hypothesis by constructing a device that could perform the functions designated above.